WILSON ENGINEERING

805 Dupont Street, Ste. #7, Bellingham, Washington 98225
Telephone: (360) 733-6100 • Facsimile: (360) 647-9061

MEMORANDUM

TO: Ian Horton, ASLA, PLA, Pacific Landscape Architecture

FROM: Michael Matthes, PE

SUBJECT: Winnie Houser Sewer Pump Station Evaluation

WILSON JOB NO.: 2019-126

DATE: 4/27/2020

The purpose of this memo is to evaluate the adequacy of the grinder pump station proposed by the City. The proposed grinder pump station is a Zoeller simplex X840 as described, and with options identified, on the attached Technical Data Sheet.

1) Understanding

The pump station will be located about 100' from the restrooms. Wastewater will flow by gravity from the restrooms to the pump station. The pump station will then pump the effluent through about 330' of 2" HDPE force main and into a gravity cleanout or manhole with no back pressure. The force main is relatively flat.

2) Flows

The proposed restroom facility will have 3 toilets, 1 urinal, and 2 sinks. Toilets and urinals will be flush valve operated. From the Uniform Plumbing Code, the number of total fixture units is estimated at 25, and the corresponding peak flow is estimated at 35 GPM.

3) System Curve

A system curve table (see attached) was developed to calculate Total Dynamic Head (TDH) versus flow from zero up to 50 GPM. Various assumptions for friction coefficient, minor head losses, and elevation were made. The calculated TDH at 35 GPM is about 13'.

4) Conclusion

Evaluation of the hydraulics indicates that the proposed pump station is adequate for the intended use. The estimated peak system flow of 35 GPM is below the pump maximum flow rate of 54 GPM, and the calculated maximum TDH of 13' is well below the pump maximum TDH of 125', as indicated on the technical data sheet. The system operating point falls within the provided pump curve. Impeller trim options and efficiencies were not evaluated.

The technical data sheet indicates that the 72" depth configuration is proposed. Once proposed surface grades and pipe inlet / outlet inverts are known, the appropriateness of this configuration, as well as proposed float settings, should be confirmed with the manufacturer.

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MEMORANDUM

Mitigation for the potential of floatation should be considered. Buoyancy calculations (see attached) were performed for the 72’ depth configuration based on a number of assumptions. The anti-floatation ring indicated as standard equipment should be at least 8” wide.

Please note that code related compliance and appropriateness were not evaluated.

Regards

Michael Matthes, PE

Attachments:
- Zoeller Technical Data Sheet
- System Curve Table
- Buoyancy calculations

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Product information presented here reflects conditions at time of publication. Consult factory regarding discrepancies or inconsistencies.

ZOELLER® PUMP COMPANY

SECTION: 2.30.080
FM2855
0519
Supersedes
1018

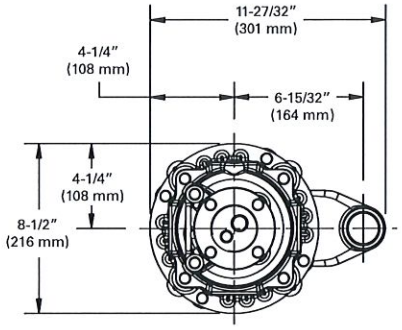
TECHNICAL DATA SHEET
EXPLOSION PROOF SERIES
THE SHARK® Series
Model X840/X841/X842 Grinder Pumps
Class I, Division 1, Groups C & D
Class I, Zone 1, Groups IIA and IIB

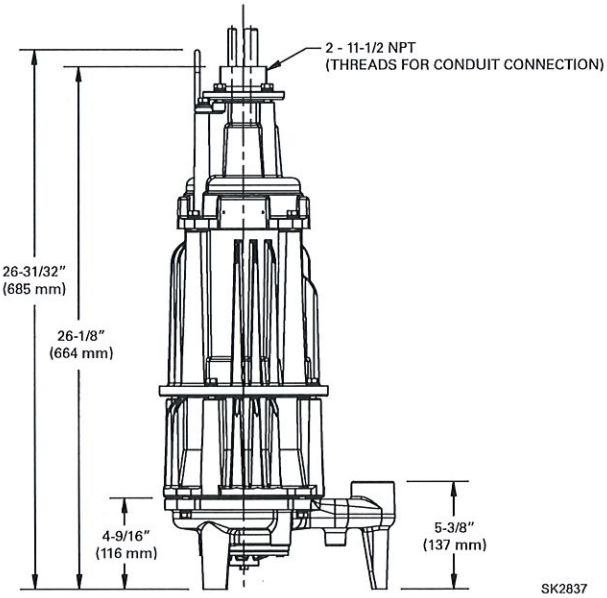
C SA US
Certified to CSA Standard C22.2 No. 145

Tested to FM Standard 3600 & 3615

PRODUCT SPECIFICATIONS

MOTOR	Horse Power	2
	Voltage	200 - 575
	Phase	1 or 3 Ph
	Hertz	60 Hz
	RPM	3450
	Type	Capacitor start / capacitor run or 3 Ph
	Insulation	Class F
	Amps	4.5 - 20.0
PUMP	Operation	Nonautomatic
	Discharge Size	1-1/4" NPT vertical
	Cord Length	20' (6 m) standard
	Cord Type	UL listed, SOOW
	Max. Head	125' (38.1 m)
	Max. Flow Rate	54 GPM (204 LPM)
	Max. Operating Temp.	104 °F (40 °C)
	Cooling	Oil filled
	Motor Protection	Auto reset thermal overload (1 Ph) or thermal sensor (3 Ph)
MATERIALS	Cap	Cast iron
	Motor Housing	Cast iron
	Adapter	Cast iron
	Pump Housing	Cast iron
	Upper Bearing	Ball bearing
	Lower Bearing	Ball bearing
	Mechanical Seals	Carbon/ceramic with stainless steel parts
	Impeller Type	Non-clogging vortex
	Impeller	Ductile iron
	Hardware	Stainless steel
	Motor Shaft	Stainless steel
	Square Rings	Neoprene
	Cutter	Hardened 440 C stainless steel, Rockwell C55-60





SK2837

NOTE: See model comparison chart for specific details.

POWDER TOUGH COATED

Submersible Wastewater Pump Association SWPA MEMBER

⚠ WARNING NOT FOR USE IN ACIDIC ATMOSPHERES.

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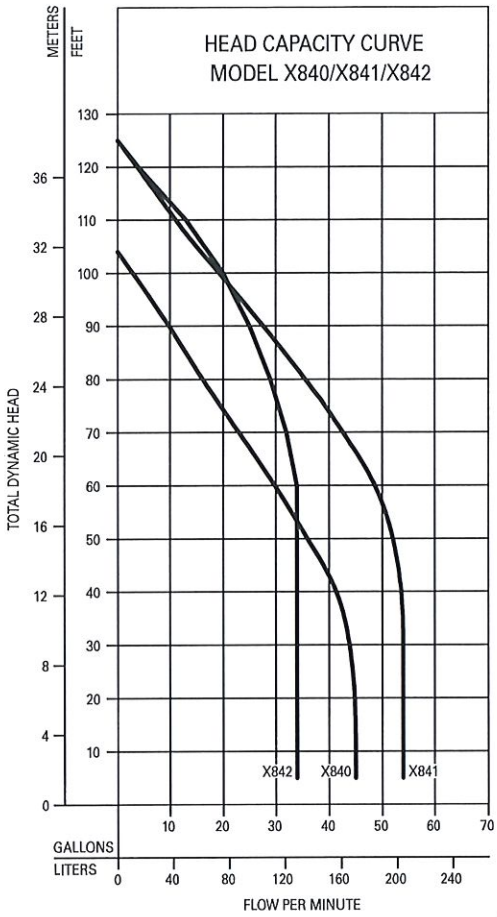
TOTAL DYNAMIC HEAD FLOW PER MINUTE

MODEL		X840		X841		X842	
Feet	Meters	Gal.	Liters	Gal.	Liters	Gal.	Liters
5	1.5	45	170	54	204	34	129
10	3.0	45	170	54	204	34	129
20	6.1	45	170	54	204	34	129
30	9.1	44	167	54	204	34	129
40	12.2	42	159	54	204	34	129
50	15.2	36	136	52	197	34	129
60	18.3	30	114	49	185	34	129
70	21.3	23	87	43	163	32	121
80	24.4	16	61	36	136	29	110
90	27.4	10	38	28	106	25	95
100	30.5	3	11	19	72	20	76
110	33.5	--	--	11	42	13	49
120	36.6	--	--	4	15	4	15
Shut-off Head:		104 ft (31.7 m)		125 ft (38.1 m)		125 ft (38.1 m)	

016532



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Model	MODEL COMPARISON							
	Mode	Volts	Phase	Amps	HP	Hz	Lbs	Kg
IX840	Non	200	1	20.0	2	60	155	70
IX841	Non	200	1	20.0	2	60	155	70
IX842	Non	200	1	20.0	2	60	155	70
EX840	Non	230	1	17.2	2	60	155	70
EX841	Non	230	1	17.2	2	60	155	70
EX842	Non	230	1	17.2	2	60	155	70
JX840	Non	200	3	12.3	2	60	155	70
JX841	Non	200	3	12.3	2	60	155	70
JX842	Non	200	3	12.3	2	60	155	70
FX840	Non	230	3	10.8	2	60	155	70
FX841	Non	230	3	10.8	2	60	155	70
FX842	Non	230	3	10.8	2	60	155	70
GX840	Non	460	3	5.5	2	60	155	70
GX841	Non	460	3	5.5	2	60	155	70
GX842	Non	460	3	5.5	2	60	155	70
BAX840	Non	575	3	4.5	2	60	155	70
BAX841	Non	575	3	4.5	2	60	155	70
BAX842	Non	575	3	4.5	2	60	155	70

Model X840 is a reversible grinder pump, and models X841 and X842 are single-direction grinder pumps.

⚠ CAUTION All installation of controls, protection devices and wiring should be done by a qualified licensed electrician. All electrical and safety codes should be followed including the most recent National Electrical Code (NEC) and the Occupational Safety and Health Act (OSHA).

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GRINDER SYSTEMS

GRINDER MODELS X840/X841/X842 VERTICAL DISCHARGE - 20' (6 m) CORDS						
	P/N	WGT.	MODEL	VOLTS	PH	AMP
☐	840-0064	155 lb (70.3 kg)	EX840	230	1¤	17.2
☐	840-0065	155 lb (70.3 kg)	IX840	200	1¤	20.0
☐	840-0066	151 lb (68.5 kg)	JX840	200	3	12.3
☐	840-0067	151 lb (68.5 kg)	FX840	230	3	10.8
☐	840-0068	151 lb (68.5 kg)	GX840	460	3	5.5
☐	840-0069	151 lb (68.5 kg)	BAX840	575	3	4.5
☐	841-0017	155 lb (70.3 kg)	EX841	230	1¤	17.2
☐	841-0018	155 lb (70.3 kg)	IX841	200	1¤	20.0
☐	841-0019	151 lb (68.5 kg)	JX841	200	3	12.3
☐	841-0020	151 lb (68.5 kg)	FX841	230	3	10.8
☐	841-0021	151 lb (68.5 kg)	GX841	460	3	5.5
☐	841-0022	151 lb (68.5 kg)	BAX841	575	3	4.5
☐	842-0011	155 lb (70.3 kg)	EX842	230	1¤	17.2
☐	842-0012	155 lb (70.3 kg)	IX842	200	1¤	20.0
☐	842-0013	151 lb (68.5 kg)	JX842	200	3	12.3
☐	842-0014	151 lb (68.5 kg)	FX842	230	3	10.8
☐	842-0015	151 lb (68.5 kg)	GX842	460	3	5.5
☐	842-0016	151 lb (68.5 kg)	BAX842	575	3	4.5

¤ Single phase units require a set of capacitors and relay starting components.

STANDARD FEATURES:

- cCSAus rated Class I, Division 1, Groups C & D and Class Zone 1, Groups IIA & IIB Construction
- Tested to FM standards 3600 and 3615 by CSA
- Reversible cutter action manual/auto**
- 1-1/4" NPT vertical discharge
- Carbon/ceramic tandem seals
- Thermal sensors** (overload on 1 Ph)
- Moisture probes**
- Vortex impeller: Ductile iron
- Stainless steel cutter and plate (R-C 55-60)
- Stainless steel shaft
- Stainless steel lifting bail
- Corrosion-resistant, powder coated epoxy paint
- 20' (6 m) power cord - 20' (6 m) sensor cord

OPTIONS:

☐ Extended cord lengths
☐ Bronze impeller
☐ Anti-siphon device

**Requires circuit in control panel to function
Reversible feature only available on X840 models

VARIABLE LEVEL FLOAT SWITCH ASSEMBLY

3 Switches with weights and brackets
☐ P/N 10-3237 WGT. 10 lb (4.5 kg)

4 Switches with weights and brackets
☐ P/N 10-3238 WGT. 14 lb (6.4 kg)

Note: All variable level float switches in this section are mechanically activated and do not contain mercury.

CONTROL PANELS						
	SIMPLEX - NEMA 4 X			DUPLEX - NEMA 4X		
MODEL		P/N	WGT.		P/N	WGT.
EX or IX840	☐	10-2709	26 lb (11.8 kg)	☐	10-2713	34 lb (15.4 kg)
FX or JX840	☐	10-2710	25 lb (11.3 kg)	☐	10-2714	31 lb (14.1 kg)
GX840	☐	10-2711	25 lb (11.3 kg)	☐	10-2715	31 lb (14.1 kg)
BAX840	☐	10-2712	25 lb (11.3 kg)	☐	10-2716	31 lb (14.1 kg)
EX or IX841, 842	☐	10-2717	24 lb (10.9 kg)	☐	10-2721	30 lb (13.6 kg)
FX or JX841, 842	☐	10-1568	24 lb (10.9 kg)	☐	10-1596	27 lb (12.2 kg)
GX841, 842	☐	10-1560	24 lb (10.9 kg)	☐	10-1588	27 lb (12.2 kg)
BAX841, 842	☐	10-2720	24 lb (10.9 kg)	☐	10-2724	26 lb (11.8 kg)

CONTROL PANEL
STANDARD FEATURES:

- NEMA 4X outdoor rating
- Intrinsically-safe relays
- Audible and visible high water alarm
- Starting, control, and alarm circuits
- Circuit breaker and rated motor contactor (1 Ph)
- Capacitors and motor starting relay (1 Ph)
- Motor-protective switch (circuit breaker/adj overloads) and rated motor contactor (3 Ph)
- Alternating circuit (duplex)
- Automatic reversing circuit (model X840 only)
- High water alarm light
- Internal seal leak light
- HOA switches and pilot light(s)
- Terminal strips
- Thermal cut-out circuit (3 Ph only)
- Padlock hasp
- UL listed
- Dry auxiliary contacts

OPTIONS:

☐ Flasher for high water alarm light
☐ Manual reset of high water alarm
☐ Elapsed time meters

For other options, please consult factory.

SIMPLEX REVERSING CONTROL BOXES*						
	AUTOMATIC			MANUAL		
MODEL		P/N	WGT.		P/N	WGT.
EX840	☐	10-0352	8 lb (3.6 kg)	☐	10-0360	7 lb (3.2 kg)
IX840	☐	10-0352	8 lb (3.6 kg)	☐	10-0360	7 lb (3.2 kg)
FX840	☐	10-0353	6 lb (2.7 kg)	☐	10-0361	5 lb (2.3 kg)
JX840	☐	10-0353	6 lb (2.7 kg)	☐	10-0361	5 lb (2.3 kg)
GX840	☐	10-0353	6 lb (2.7 kg)	☐	Not available	
BAX840	☐	Not available		☐	Not available	

*These control boxes consist of the reversing mechanisms and capacitors (1 Ph units) only. They will not control pumps. Refer to Section B for complete system controls. For duplex applications use two simplex reversing control boxes. (For pump prefix identification see News & Views 0052)

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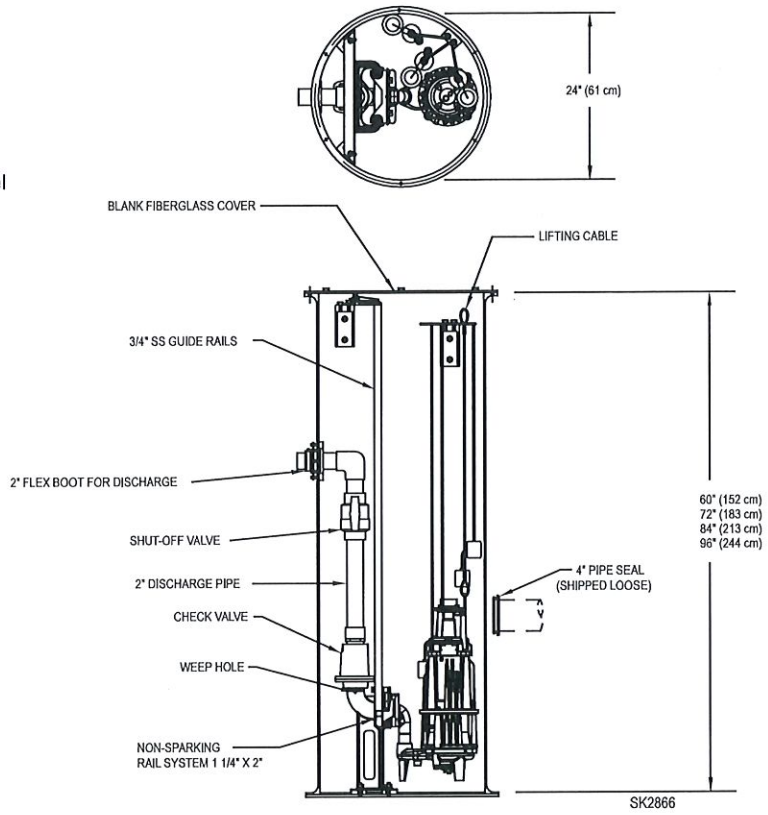
OUTDOOR BASIN, COVER, AND RAIL SYSTEM ASSEMBLIES
STANDARD EQUIPMENT

- Fiberglass basin with anti-flotation ring
- (2) Steel electrical couplings
- 2" PVC discharge pipe from disconnect
- 2" Adaptaflex discharge pipe seal
- Non-sparking Z-Rail® disconnect system
- 8' (2.4 m) stainless steel lifting cable
- 3/4" stainless steel rail pipe
- For basin depths to 84" (213 cm) [2' (3.7 m) stainless steel lifting cable for basin depths of 96" (244 cm)]
- 2" PVC ball valve(s)
- 2" cast iron check valve(s)
- 1-4" rubber inlet pipe seal (field-installed)
- Blank fiberglass cover with Zoeller imprint



SIMPLEX

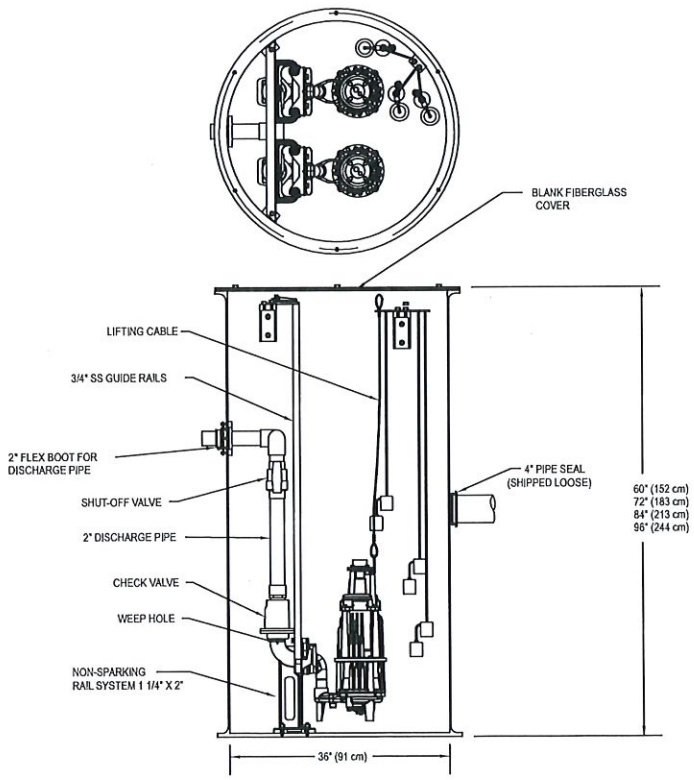
☐	24" x 60" (61 x 152 cm)	P/N 33-0998 WGT. 189 lb (85.7 kg)
☐	24" x 72" (61 x 183 cm)	P/N 33-0999 WGT. 192 lb (87.1 kg)
☐	24" x 84" (61 x 213 cm)	P/N 33-1000 WGT. 213 lb (96.6kg)
☐	24" x 96" (61 x 244 cm)	P/N 33-1001 WGT. 235 lb (106.5kg)

DUPLEX

☐	36" x 60" (91 x 152 cm)	P/N 33-1002 WGT. 393 lb (178.2kg)
☐	36" x 72" (91 x 183 cm)	P/N 33-1003 WGT. 468 lb (212.2kg)
☐	36" x 84" (91 x 213 cm)	P/N 33-1004 WGT. 533 lb (241.7 kg)
☐	36" x 96" (91 x 244 cm)	P/N 33-1005 WGT. 593 lb (268.9 kg)

- Larger diameter or deeper basins (Allow for overhead clearance)

PUMP NOT INCLUDED



-- PREPACKAGED CHECKLIST --

SIMPLEX

(1) Grinder pump	P/N _____
(1) Simplex control panel	P/N _____
(1) Float switch assembly	P/N _____
(1) Prepackaged basin assembly	P/N _____

DUPLEX

(2) Grinder pump	P/N _____
(1) Duplex control panel	P/N _____
(1) Float switch assembly	P/N _____
(1) Prepackaged basin assembly	P/N _____

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SYSTEM CURVE

CLIENT: City of Sedro-Woolley
PROJECT DESCRIPTION: Winnie Houser Park
DATE: 27-Apr-20

TBL1-Friction Head Loss 2 **inch Force Main** HDPE Elevation Increase = 3 feet

STEP = 5													
Flow Q *gpm*	**Flow** Q *cfs*	**Diameter** D *in*	**Area** A *sf*	**Velocity** v *ft/sec*	**Hazen-Williams Constant** Cmin	**Hazen-Williams Constant** Cmax	**Pipe Length** L *ft*	**Friction Head Loss C =** 140 HL(ft)	**Friction Head Loss C =** 140 HL(ft)		**Minor Head Loss** HL (ft)	**Elevation Head Loss** HL (ft)	**Total Head Loss** TDH (ft)
0	0.00	2	0.02	0.00	140	140	330	0.00	0.00		0.00	3	3.00
5	0.01	2	0.02	0.51	140	140	330	0.25	0.25		0.02	3	3.26
10	0.02	2	0.02	1.02	140	140	330	0.89	0.89		0.07	3	3.96
15	0.03	2	0.02	1.53	140	140	330	1.88	1.88		0.17	3	5.05
20	0.04	2	0.02	2.04	140	140	330	3.20	3.20		0.30	3	6.50
25	0.06	2	0.02	2.55	140	140	330	4.84	4.84		0.47	3	8.31
30	0.07	2	0.02	3.06	140	140	330	6.79	6.79		0.67	3	10.46
35	0.08	2	0.02	3.57	140	140	330	9.03	9.03		0.92	3	12.95
40	0.09	2	0.02	4.09	140	140	330	11.56	11.56		1.20	3	15.76
45	0.10	2	0.02	4.60	140	140	330	14.38	14.38		1.52	3	18.90
50	0.11	2	0.02	5.11	140	140	330	17.48	17.48		1.87	3	22.35

TBL 2 - Minor Head Loss 2 **inch Force Main**

Flow Q *gpm*	**Flow** Q *cfs*	**Diameter** D *in*	**Area** A *sf*	**Velocity** v *ft/sec*	v^2/2g	**Head Loss Coefficient** K	**Total Minor Head Loss** HL *ft*
0	0.00	2	0.02	0.00	0.00	4.62	0.00
5	0.01	2	0.02	0.51	0.00	4.62	0.02
10	0.02	2	0.02	1.02	0.02	4.62	0.07
15	0.03	2	0.02	1.53	0.04	4.62	0.17
20	0.04	2	0.02	2.04	0.06	4.62	0.30
25	0.06	2	0.02	2.55	0.10	4.62	0.47
30	0.07	2	0.02	3.06	0.15	4.62	0.67
35	0.08	2	0.02	3.57	0.20	4.62	0.92
40	0.09	2	0.02	4.09	0.26	4.62	1.20
45	0.10	2	0.02	4.60	0.33	4.62	1.52
50	0.11	2	0.02	5.11	0.40	4.62	1.87

Headloss Coefficient

Pipe Diameter: 2			
Item	Loss Coef.	Quantity	Product
Entrance	0.050	1	0.05
Exit	1.000	1	1
F 90	0.330	4	1.32
F 45	0.140	3	0.42
T-run	0.140	0	0
T-Branch	0.650	0	0
Check Valve	1.000	1	1
Plug Valve	0.730	1	0.73
Gate Valve	0.100	1	0.1
Butterfly Valve	0.000	0	0
30"x20" Reducer	0.1	0	0
meter?	0	0	0
Other	0	0	0
Other	0	0	0
Minor Headloss Coefficient			**4.62**

Buoyancy Calculations

Project: City of Sedro-Woolley Winnie Houser Park
Date: 04/27/2020
Facility: Sewer Pump Station
By: Michael Matthes

Assumptions:

SHGW = Surface
Soil Density Saturated (Ysat) = 60 pcf
PS diameter = 2', Weight w/o pumps = 190 lb
Base Extension = 8"
Ywater = 62.4 lb/cft

1) Upward Buoyancy Force Fb

Volume displaced water = π x r^2 x D = π x1 x 6 = 20 cft
Fb = 20 x 62.4 = 1,200 lb

2) Downward Weight Force Fw

Pump Station:

Fw = 190 lb given.

Soil:

For 8" base extension
Vol = π x D x 0.67 x 6 = π x 2.65 x 0.67 x 6 = 33 cft
Fw Soil = 33 x 60 = 1,980 lb

Total Fw = 190 + 1,980 = 2,170 lb

3) Downward Friction Force Ff

NA.

4) Safety Factor SF

SF = Fw / Fb = 2,170 / 1,200 = 1.8
1.8 > 1.5 ……. OK.